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GB 2277460 A EP 0709525 A1 EP 0636751 A1
WO 98/31882 A1

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(54) Abstract Title
**Screen for edge of overflow weir**

(57) Screening apparatus comprises a screening element disposed adjacent a weir edge 12 of a channel in which a screenings/liquid mix flows normally beneath the level of the screening element, the screening element being provided internally of the channel and presenting a separation surface to the flow when swollen to a level at which it comes into contact with the screening element, so that any liquid passing over the weir edge has first passed through the screening element. As described the screening element is formed from a plurality of part-cylindrical plates 6 linked together into a closed loop 10 which passes around a a pair of sprockets 26, 28 one or more of which may be driven when the flow contacts the plates. A driven brush 34 may clean the plates and return screenings into the flow. The plates may have holes 6 mm. in diameter. The screening element may extend halfway across the flow channel and its open side may be closed by a fixed plate. In an alternative arrangement the brush 34 is dispensed with.

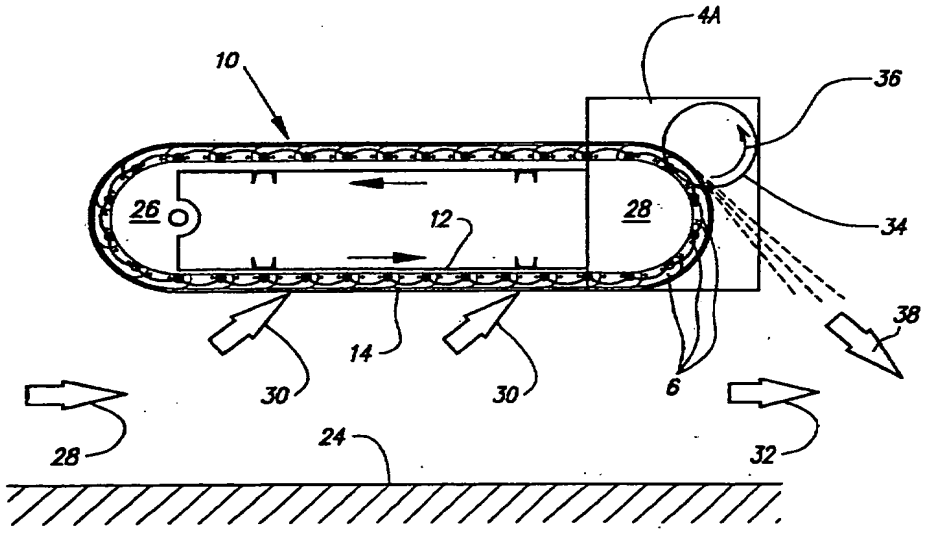


FIG. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

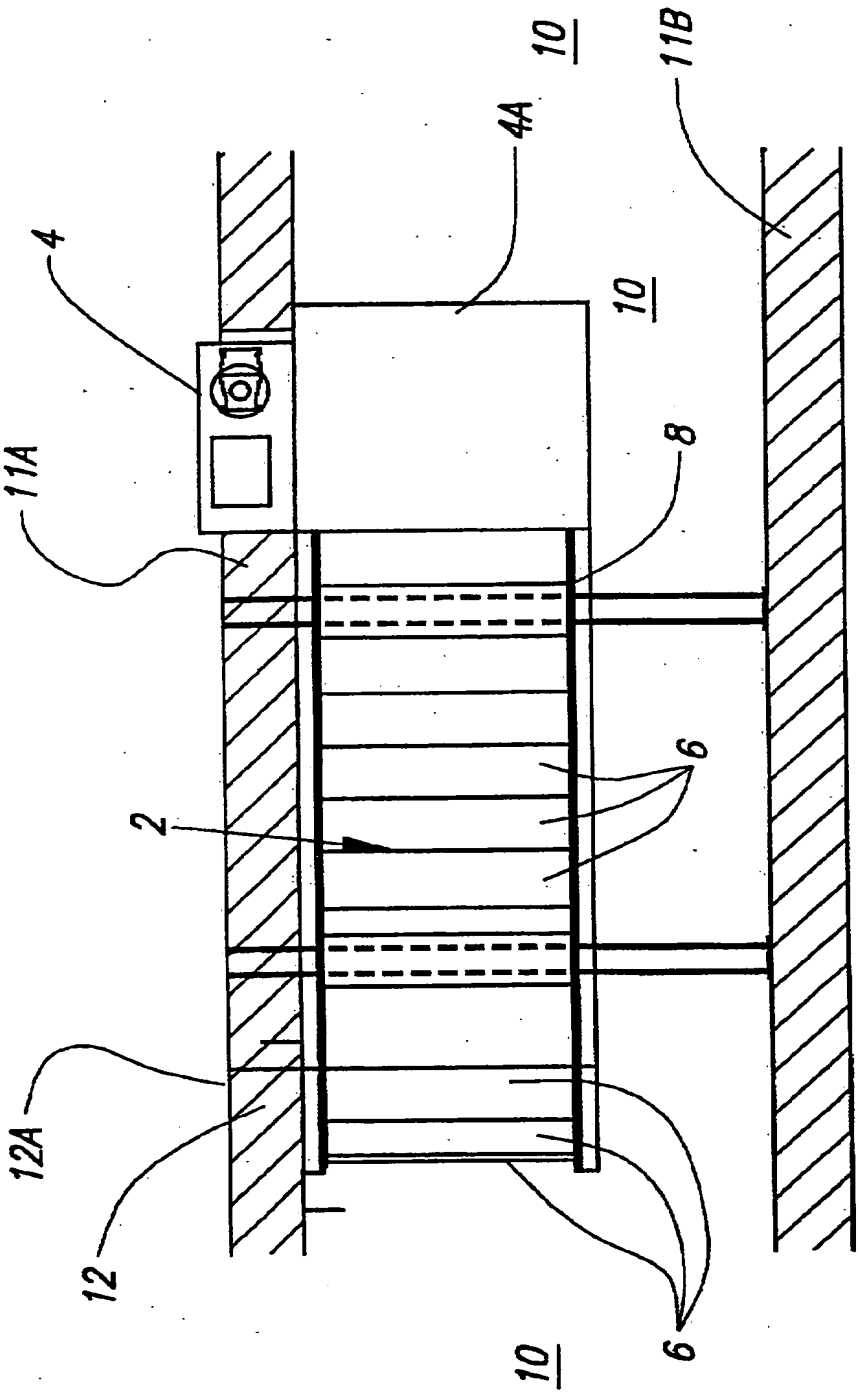


FIG. 1

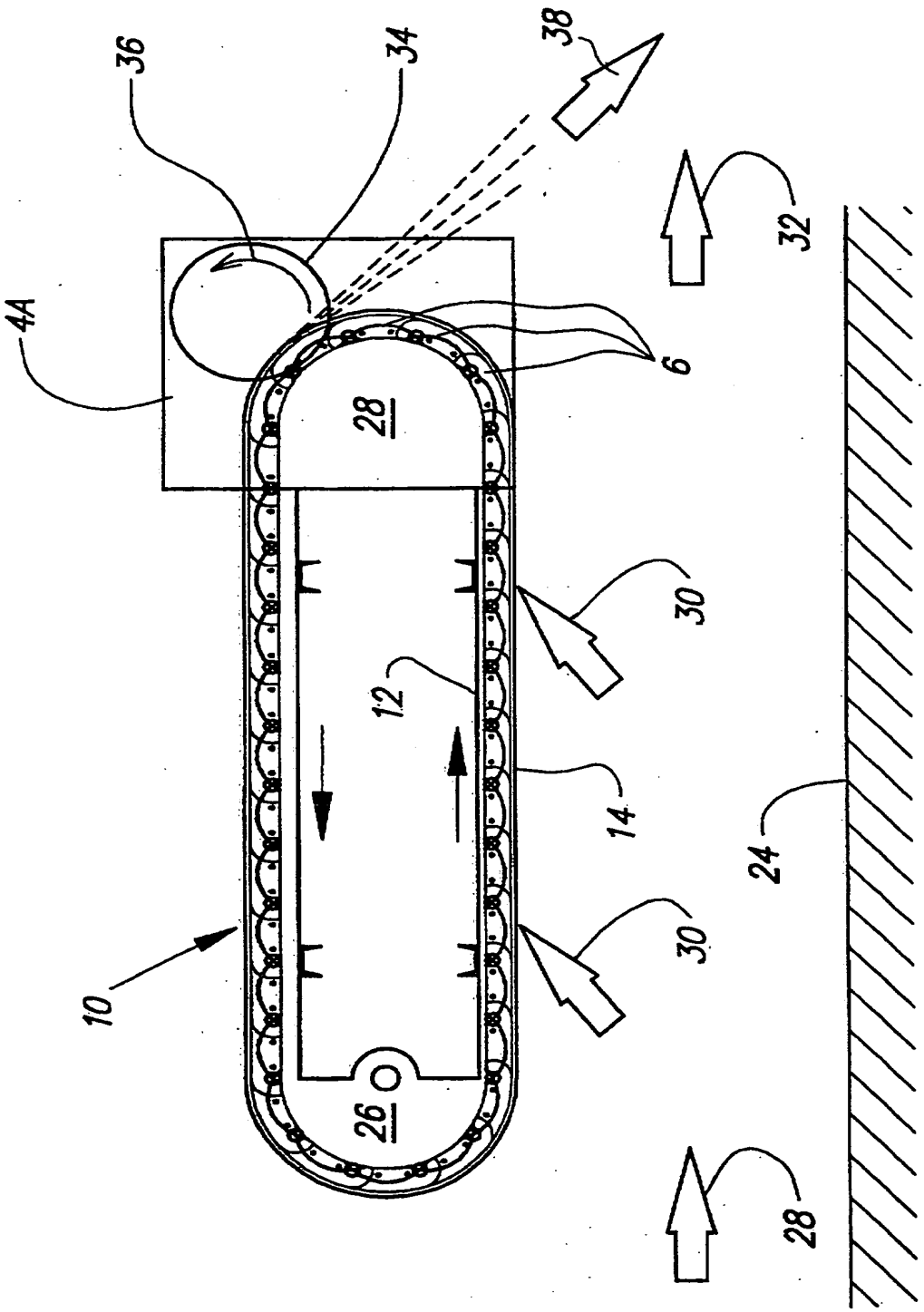


FIG. 2

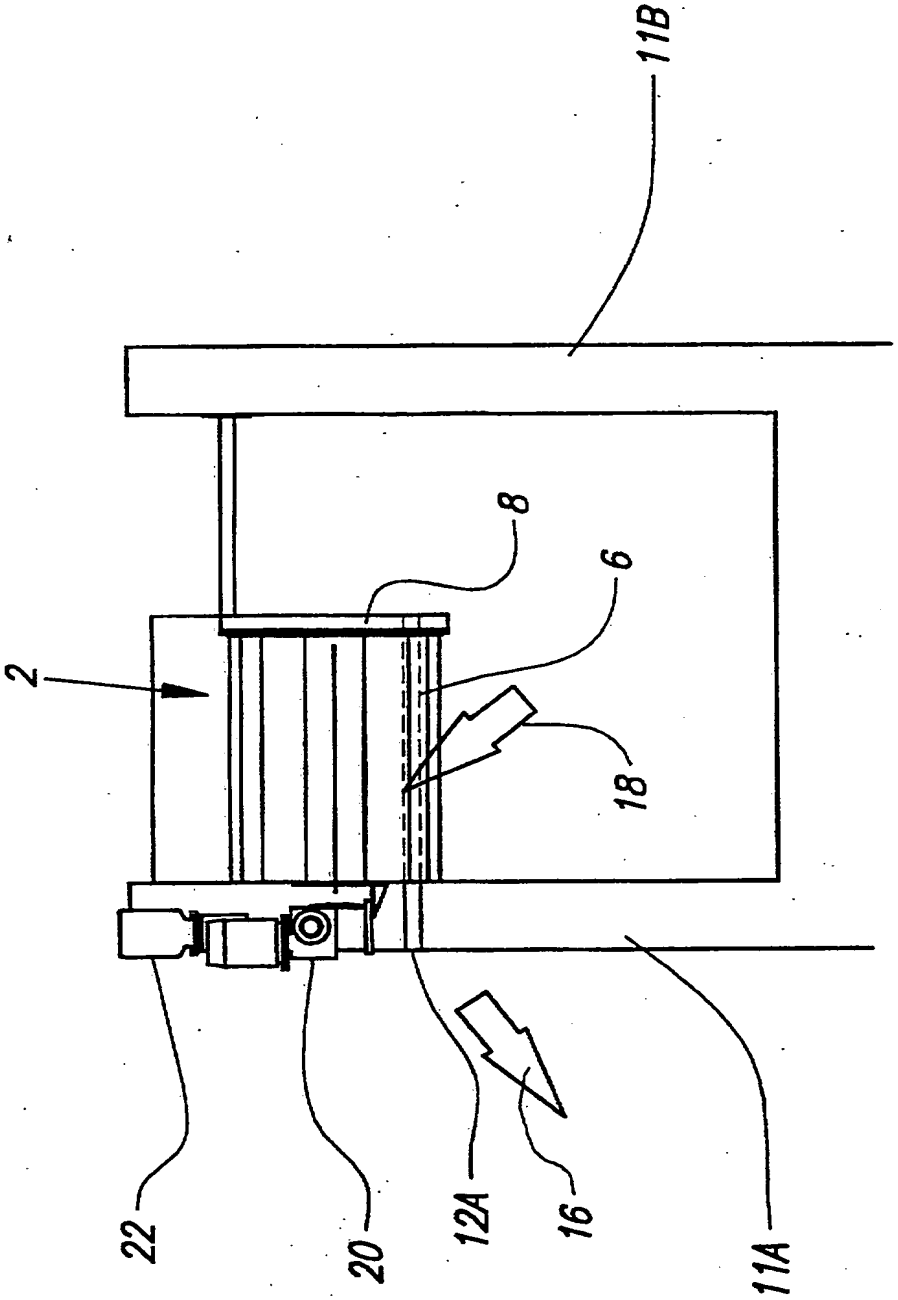


FIG. 3

# Weir Screen

This invention relates to a weir screen, and more specifically to a weir screen of the type which is commonly provided parallel to a water channel and is only activated in storm or flood conditions during which the water level within the channel rises above the level of the weir and there is a need to provide screening apparatus to ensure that the screenings, being solid material of a predetermined size are maintained in or are returned to the fluid flow, or are suitably disposed of. In this specification, "screenings" is intended to have the meaning provided above, and cognate expressions shall be construed accordingly.

It should be pointed out that although this application is primarily concerned with the provision of screening apparatus proximate a weir edge which defines a channel in which flows a particularly undesirable solid/liquid mix, such as raw sewage, the apparatus herein described may be used in other more sanitary applications where there is a requirement that solid material contained within a flow of liquid is returned to said flow if the flow level rises over the edge of the channel in which that flow occurs.

Modern screening apparatus is commonly disposed along weir edges on either side of a channel in which a fluid/screenings flow is continuously occurring. The apparatus are provided parallel with the direction of flow and adjacent the weir edges, and under normal flow conditions, the level is normally below the edge of the weir thus ensuring that the screenings are maintained in the flow of liquid and within the channel. However, in storm or mild flood conditions, the flow level often rises above the edge of the weir edges and in the absence of screening apparatus, the liquid/screenings mix would cascade over the weir edges. Although the liquid may harmlessly be absorbed by the surrounding earth and

returned to the aquifer, the screenings would not be so absorbed and would result in an unsightly and unhygienic disposal thereof.

An example of existing apparatus is described in European Patent No. 0596332 to Huber, and in a primary embodiment of the invention covered thereby, a semi-circular screen having apertures therein to allow separation of the screenings from the liquid is disposed adjacent a weir edge such that the axis of the imaginary cylinder around the periphery of which the screen is disposed is substantially aligned and parallel with the weir edge. A rotationally driven Archimedes screw type device is disposed immediately above the screen and its axis of rotation is generally concentric with the axis of the imaginary cylinder mentioned above. The Archimedes screw type device has a shaft around which the screw spirals along the length of said shaft, which is the same length as the screen. The screw is provided with a plurality of bristles protruding from the edge thereof so that during storm or light flood conditions when the device is activated and the shaft is rotated, the bristles scrub progressively along the length of the screen and thus screwingly move solids collected on the screen therealong.

In general the orientation of the Archimedes screw is such that screenings collected on the screen are moved in the direction of conventional flow within the channel defined by the weir edges over which the excess flow has cascaded, and at the end of the screen there is conventionally provided a trough beneath the screen into which the screenings fall after being urged over the edge by the screw action of the Archimedes screw type device. Additional screenings transfer apparatus is required to empty the contents of this trough periodically back into the flow within the channel, or alternatively the transfer of separated screenings may be a continuous process.

In any event, the fundamental disadvantage of this type of apparatus is that additional transfer apparatus is required at the end of the screen to ensure that the screenings are returned to the flow.

Other stormwater screening apparatus have been proposed such as raked bar storm screens (consisting essentially of a plurality of vertical plate screens which require periodic cleaning), or cross-wave screens (such as those sold by Copa in the UK) for which automatic cleaning systems can be provided at significant additional cost.

It is accordingly an object of this invention to provide screening apparatus which does not require additional screenings transfer means to return the screenings collected in the apparatus back to the liquid/screenings fluid flow within the channel alongside which the apparatus is disposed.

It is a further object of this invention to provide screening apparatus which ensures effective separation of screenings from a liquid/screenings flow to ensure that only screened water escapes over a weir.

According to the invention there is provided a screening apparatus having one or more screening elements disposed adjacent a weir edge of a channel in which a screenings/liquid mix flows normally beneath the level of the screening element, said apparatus further having screen element cleaning means which contact the screen element and the configuration of the apparatus being such that there is relative movement between the screen and the cleaning means to enhance the cleaning effect, characterised in that the screen is provided internally of the channel and presents a separation surface to the flow when swelled to a level in which it comes into contact

with said screen element so that any fluid passing over the weir edge has first passed through the screen.

In a most preferred embodiment the apparatus is provided with a plurality of screen elements coupled together to form a loop, the coupling permitting relative rotation of adjacent elements.

The loop of screen elements is preferably disposed around sprockets mounted on substantially horizontal axles preferably disposed at either end of the weir edge along which the apparatus is to provide a screening effect. One or both of the sprockets is preferably motor driven, the drive being initiated when the flow level swells and comes into contact with the screen.

It is most preferable that the lower section of the loop of screen elements which provides the screening function for a swelled flow is disposed within the channel marginally below the level of the weir edge.

Most preferably the screen elements have a cross-sectional profile which allows a complementary interlocking connection of adjacent elements.

Preferably the screen elements are of a width equal to half that of the channel in which the apparatus is provided, although it is considered that the elements my be equal in width to that of the channel in which case the entire width of flow would be subjected to screening. In the former circumstance, it is desirable to provide a cover on the side of the apparatus which is remote from the weir edge to ensure that unscreened flow does not pass into the apparatus and thus over said weir edge.

Preferably the screen is driven such that the lower side of the loop on which the screening occurs moves in a direction parallel with the flow direction.

Preferably the cleaning means is a circular brush rotationally driven so that bristles thereof move in an opposite direction to the screen elements with which they come into contact to effect a scrubbing action thereon.

Most preferably the action of the brush on the screening elements is to scrubbingly remove screenings material therefrom and to spray same back into the flow passing therebeneath.

Preferably the brush is mounted on a stationary horizontal axis proximate a portion of the screen loop which is curved by virtue of the conformation of the loop to the sprockets around which the loop is disposed and by which it is moved relative to the brush.

Preferably the axial dimension of the brush is substantially the same as the width of the screen elements.

Most preferably the brush axle and the sprocket axle adjacent which the brush axle is disposed are rotationally independently driven by different motors and are provided together in an enclosure downstream of the first sprocket. In the alternate the applicant considers it feasible to provide the brush with a chain drive operatively coupled to a main screen drive shaft so that both brush and screen can be driven and operated by the same motor.

Preferably the screen elements are provided with a pattern of apertures on their front face, said apertures being preferably 6mm in diameter.

It is also been proposed to dispense with the brush entirely as it will be understood by those skilled in the art that the action of the screenings themselves being driven along by the flow within the channel and against the lower surface of the belt during flood conditions may in itself provide a cleaning action such that wet screening elements rotated around the downstream sprocket out of the fluid flow may be substantially clean.

Accordingly in a second aspect of the invention there is provided a screening apparatus having one or more screening elements disposed adjacent a weir edge of a channel in which a screenings/liquid mix flows normally beneath the level of the screening element, characterised in that the screen is provided internally of the channel and presents a separation surface to the flow when swelled to a level in which it comes into contact with said screen element so that any fluid passing over the weir edge has first passed through the screen.

The preferable features of the invention mentioned above are equally applicable to this second aspect of the invention.

The provision of a horizontal screening face within the flow channel and which moves parallel with the flow has a number of advantages over the conventional arrangement where the screenings/liquid mix is allowed to cascade over a weir edge and into a circular screening trough within which an Archimedes screw type device is rotated. Firstly, the applicant for the present invention has realised that by disposing the screening surface internally of the channel and by providing a brush proximate the screen elements, the screenings collected on the elements can be scraped therefrom and are simply thrown or sprayed by the action of the brush, or even more simply drop back into the flow within the channel. There is therefore no

reason to provides separate and dedicated screenings transfer apparatus.

The disposition of the apparatus within the channel and the various sealing arrangements ensure that as the flow within the channel swells, and at least partially comes into contact with the horizontal screen elements, screening thereof must take place if any liquid is to escape over the weir edge. Thus the apparatus ensures that "carry-over" of screenings is impossible.

Fourthly, the motor drive components can be compartmentalised in a single enclosure provided at one end of the apparatus, preferably the downstream end. When the screen elements are in motion, the lower surface of this enclosure can be open such that screenings removed from the screen elements can simply drop back into the foul flow beneath the enclosure.

A specific embodiment of the invention is now provided by way of example with reference to the accompanying diagrams wherein:

Figure 1 shows a plan view of apparatus according to the invention,

Figure 2 shows a sectional view on AA as shown in Figure 1, and

Figure 3 shows a sectional view on BB as shown in Figure 1.

Referring firstly to Figure 1 there is shown screening apparatus indicated generally at 2 consisting of a housing 4, 4A which contains motorised drive means for moving a conveyor type arrangement of a plurality of horizontal screen elements 6 interlinked to form a loop 10, as can be seen in Figure 2. The screen elements 6 are provided with a plurality of apertures which allow the separation of liquid from solid screenings to a diameter of 6 mm. Any smaller screenings

will be able to pass through the apertures, but this is acceptable under modern legislation.

The apparatus 2 is mounted within a channel 10 defined by channel walls 11A, 11B in which there is a liquid/screenings flow and which in storm or flood conditions can swell within the said channel to a level proximate the level of a weir 12 having an edge 12A on one side of the channel. The mounting of the apparatus 2 is such that a lower surface 14 of the conveyor loop 10 is marginally below the level of the weir edge 12A. The side of the apparatus remote from the weir edge is covered with a solid endplate 8 to prevent the flow of the liquid/screenings mix from passing into the inside of the conveyor loop 10 and over the edge of the weir without having been subjected to a screening operation or exposed to a screening surface.

It will be instantly appreciated from Figure 3 that the apparatus is provided over only a portion of the width of the channel, although the invention is not to be considered as strictly limited to such width. It can also be seen that any flow over the weir edge 12A as shown by arrow 16 must first have passed through the screen elements 6 within the channel as shown by arrow 18. Also in Figure 3, motors 20, 22 are shown for driving the conveyor-type interlinked screen elements and the brush respectively. It will be appreciated that these motors could be combined into a single drive unit.

It is important to note that the apparatus according to the present invention is "over-toppable", which means that in conditions of extreme or freak flood, in which the flow within the channel swells such that its level rises above the upper edge of the end plate 8, the flow can cascade onto the upper surface of the conveyor loop 10 and subsequently over the weir edge without effective screening.

Such conditions may be experienced every 100 years or so, but in any event this apparatus can accommodate such flow.

It should be pointed out that the length of the overall apparatus can be adjusted to suit the length of the weir adjacent which the apparatus is to be provided.

Referring particularly to Figure 2, there is shown a sectional view of the apparatus mounted within the channel 10, the floor of which is shown at 24. The conveyor loop 10 is disposed around a pair of sprockets 26, 28 provided with teeth which engage a chain or like connector and thus drive the conveyor. It is preferable that the conveyor 10 is driven such that the direction of travel of the lower surface 14 is parallel with the direction of flow within the channel. In this manner, the screenings are less likely to be forced through the screen elements during conditions of large flow swell. The flow directions are shown by arrows 28, 30, and 32 which respectively indicate the total flow, the screened storm flow, and the foul flow in which the solid screenings are contained and to which said screenings are return after having been removed from the elements as described below.

Within the casing 4A there is provided a brush 34 which is rotationally driven in a direction shown by arrow 36, the bristles of which come into scrubbing contact with each element 6 as it passes thereby. It will be appreciated by those skilled in the art that the particular direction of travel of the brush 34 ensures that screenings removed from the elements 6 may be sprayed in a direction indicated at 38 back into the channel and into the foul flow 32. Hence no separate and dedicated screenings transfer means is required to ensure that screenings collected on the elements are returned to the foul flow.

It is also to be mentioned that although a most favourable orientation of the screening apparatus is substantially horizontal so that the surfaces of the screening elements are substantially parallel with the surface of the fluid flow within the channel, this is not absolutely necessary, and indeed the orientation of the screening apparatus may be inclined to as opposed to perpendicular with the walls of the channel in which the fluid flows.

It is also worth mentioning that an alternative arrangement may include a single cylindrical perforated screening element having an archimedian screw brush as described in EP0596332 abovementioned disposed therein. The cylindrical screen (as opposed to a screen having a merely semi-circular cross-section) or the brush within could be rotated to drive screenings caught within the cylindrical screen towards an open end thereof where, if the screen was disposed within the channel in which fluid flow occurred as is an essential feature of this invention, said screenings could simply fall back into the flow. Hence it is not mandatory that the screening apparatus of this invention be comprised of a plurality of screen elements coupled together to form a belt capable of being driven. More important is the disposition of the screen apparatus within the fluid flow channel where it acts as a barrier to the rising fluid during flood conditions so that said fluid escaping over a weir edge adjacent which the apparatus is disposed is firstly be screened.

## CLAIMS

1. A screening apparatus having one or more screening elements disposed adjacent a weir edge of a channel in which a screenings/liquid mix flows normally beneath the level of said one or more screening elements, said screening element permitting fluid flow therethrough but preventing solid matter of a predetermined size from passing therethrough, said apparatus further having screen element cleaning means which contact the one or more screen elements and the configuration of the apparatus being such that there is relative movement between the one or more screen elements and the cleaning means to clean the said one or more elements during operation of said apparatus, characterised in that the one or more screen elements is disposed internally of the channel adjacent the weir edge thus presenting a separation surface to the flow when swelled to a level in which it comes into contact with the screen element(s) or part thereof so that any fluid passing over the weir edge in swelled flood conditions has first passed through the screen.

2. Apparatus according to claim 1 wherein at least part or some of the said one or more screen elements is disposed at least partially beneath the level of the weir edge.

3. Apparatus according either of claim 1 or 2 wherein a plurality of screen elements are coupled together to form a continuous loop which is operatively moveable in conveyor fashion, said coupling permitting relative rotation of adjacent screen elements.

4. Apparatus according to either of claim 1 or 2 wherein a single arcuate screen element is disposed within the channel adjacent the weir edge.

5. Apparatus according to any of claims 1-3 wherein the loop of screen elements is disposed around sprockets mounted on substantially axles disposed at either end of the weir edge along which the apparatus provides a screening effect.

6. Apparatus according to claim 5 wherein one or both of the sprockets is motor driven, said motor being operated when the fluid flow level swells and comes into contact with the lowermost portion of said screen elements.

7. Apparatus according to any of claims 3, 5 or 6 wherein the lower section of the loop of screen elements which provides the screening function for a swelled flow is disposed within the channel below the level of the weir edge.

8. Apparatus according to any of claims 3, 5-7 wherein the screen elements have a cross-sectional profile which allows a complementary interlocking connection of adjacent elements.

9. Apparatus according to any of claims 3, 5-8 wherein the screen elements are of a width equal to half that of the channel in which the apparatus is provided

10. Apparatus according to claim 9 wherein a cover plate is provided on the side of the apparatus which is remote from the weir edge to ensure that unscreened flow does not pass into or over the apparatus and thus over said weir edge during conditions of swelled flow, said cover plate being of a height which allows for over-topping of fluid and screenings during extreme or freak flood conditions.

11. Apparatus according to any of claims 3, 5-10 wherein the screen is driven such that the lower side of the loop on which the

screening primarily occurs moves in a direction parallel with the flow direction.

12. Apparatus according to any of claims 3, 5-11 wherein the cleaning means is a circular brush rotationally driven so that bristles thereof move in an opposite direction to the screen elements with which they come into contact to effect a scrubbing action thereon.

13. Apparatus according to claim 12 wherein the action of the brush on the screening elements and its disposition with respect to the screening belt is to scrubbingly remove screenings material therefrom and to spray same back into the flow passing therebeneath.

14. Apparatus according to either of claims 12 or 13 wherein the brush is mounted on a stationary horizontal axis proximate a portion of the screen loop which is curved by virtue of the conformation of the loop to the sprockets around which the loop is disposed and by which it is moved relative to the brush.

15. Apparatus according to any of claims 12-14 wherein the axial dimension of the brush is substantially the same as the width of the screen elements.

16. Apparatus according to any of claims 12-15 wherein the brush axle and the sprocket axle adjacent which the brush axle is disposed are rotationally independently driven by different motors, and are provided together in an enclosure downstream of the first sprocket.

17. Apparatus according to any preceding claim wherein the screen elements are provided with a pattern of apertures on their front face.

18. Apparatus according to claim 17 wherein said apertures are 6mm in diameter.

19. A screening apparatus having one or more screening elements disposed adjacent a weir edge of a channel in which a screenings/liquid mix flows normally beneath the level of said one or more screening elements, said screening element permitting fluid flow therethrough but preventing solid matter of a predetermined size from passing therethrough, characterised in that the one or more screen elements is disposed internally of the channel adjacent the weir edge thus presenting a separation surface to the flow when swelled to a level in which it comes into contact with the screen element(s) or part thereof so that any fluid passing over the weir edge in swelled flood conditions has first passed through the screen.

20. Apparatus according to claim 19 wherein screen element cleaning means is provided which contact the one or more screen elements and the configuration of the apparatus being such that there is relative movement between the one or more screen elements and the cleaning means to clean the said one or more elements during operation of said apparatus.

INVESTOR IN PEOPLE

**Application No:** GB 0017331.0 **Examiner:** Geoff Nicholls
**Claims searched:** All **Date of search:** 15 December 2000

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B1D (DMLC DNGA DNRS)

Int Cl (Ed.7): E03F 5/14

Other: ONLINE: WPI, EPODOC, JAPIO

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| X | GB 2277460 A | (NILL) See especially Figure 2, and weir edge 9 | 1, 2, 19, 20 |
| X | EP 0709525 A1 | (BORMET) Whole document relevant | 1, 2, 19, 20 |
| X | EP 0636751 A1 | (GIEHL) See especially Figure 2 | 19 |
| X | WO 98/31882 A1 | (CORCORAN) See especially Figure 6 | 1, 2, 19, 20 |

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|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
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